Staff summary

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MTI Structural Research Program

A program overview by Organizational Results

Background

The MTI structural research program had two overall objectives:
1) Extend the service life of existing bridges, and
2) Optimize MoDOT's design and construction of new bridges to reduce costs.

The research program consisted of six separate projects all focused on one of these two objectives. Researchers from three different Missouri Universities, four MoDOT divisions, and several MoDOT districts collaborated on this research program. Project successes include developing new specifications to eliminate spalling of precast panels, reducing the cost of steel bridges by approximately 7%, developing new approach slab designs to save approximately $10,000 per bridge and development of a Visual Inspection Guide for bridge inspectors to aid in MoDOT's asset management of bridges.

Project Findings

Project 1a. Structural Steel Coatings for Corrosion Mitigation

Researchers performed extensive laboratory testing on many structural steel coatings, including those already used by MoDOT and other paints on the market. A new polyurea coating was tested and found to work well. This spring MoDOT forces will be applying this coating to a MoDOT bridge.

The study also showed MoDOT's current recoating system works well on bridges with good drainage. However, early failures occurred when roadway salts continued to drain on the steel girders. The research determined it would be worth the expense of addressing drainage issues on recoating projects to extend the life of those projects. Over the last three years, MoDOT spent over $22 million on recoating bridges. The cost of repairing the drainage system is minimal when it could double or triple the service life of a recoating project.

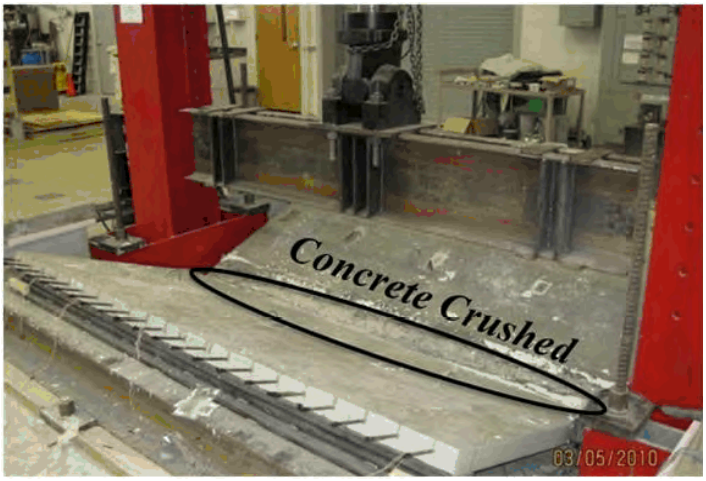
Field inspection of existing bridge coatings

Finally, researchers developed a Visual Inspection Guide, which will be implemented by the bridge inspectors starting with the 2011inspection season. This guide has pictures for each possible bridge rating to help make ratings more consistent. The guide is also more focused toward providing information when remedial work needs to be scheduled.

Project Findings (cont'd.)

1b. Spalling Solution of Precast-Prestressed Bridge Deck Panels

Several MoDOT bridges have shown deterioration of the prestressed panels on the underside of the deck. This research project focused on the causes of the deterioration, solutions for fixing the problems and design changes to prevent the deterioration in the future. The research found several no-cost changes can be implemented to reduce the risk of panel deterioration. Standard plans are being changed to move the location of the first tendon and lifting hooks to reduce the risk of cracking. Specifications are also being changed to call for sealing all joints between the panels instead of just at locations that don't meet tolerances. A few low-cost preventative additives were studied, and MoDOT will pilot two of these: fiber additives and a corrosion inhibitor. The pilots will provide MoDOT accurate information on whether the additives are cost-effective solutions.



Testing new panel designs

2a. Calibration of the Live Load Factor in LRFD Design Guidelines

Calibration of the factors used to design bridges is intended to be applied to the entire nation and the loading information is based on truck traffic in a Canadian Province in the 1970s. By looking at the actual traffic experienced on Missouri bridges, MoDOT is able to take a "practical design" approach to design bridges more efficiently. The researchers provided MoDOT with the live- load calibration factors for both moment and shear based upon average daily truck traffic experienced in Missouri. The largest savings will be seen in steel bridges. Based off the number of steel bridges in 2008 and 2009, MoDOT would save $2.4 million.

Wet phase testing of rebar coatings

2b. Coated Steel Rebar for Enhanced Concrete - Steel Bond Strength and Corrosion Resistance

MoDOT currently uses an epoxy coating on reinforcing steel to protect the steel from corrosion from deicing salts. Some states have moved away from the epoxy coating, and this research took a look at new enamel technology for protecting reinforcing steel. The enamel coated rebar provides an excellent bond with the steel and has been used in buildings that need to resist earthquakes and blasts. However, the research found the technology and formulation is not ready for widespread implementation on Missouri bridges at this time. The research also found that the epoxy coating being used by MoDOT works better and is currently the most efficient solution.

2c. Bridge Approach Slabs for Missouri DOT- Alternative and Cost Efficient Approaches

Bridge approach slabs are used on most bridges to allow a smooth transition between the roadway and bridge. While important, bridge approach slabs can be costly. This project looked at ways to reduce the initial and life-cycle cost of bridge approach slabs. Three different approach slabs were developed as part of this research, a 20-foot approach with a sleeper slab for major roadways, a 25-foot approach without a sleeper slab for minor roadways, and a precast approach slab for locations where a quick construction is required. While the cost savings per bridge is about $10,000, this would have equated to over a million dollar saving over the last 3 years.

Pouring a bridge approach slab

2d. Calibration of Load and Resistance Factors in LRFD Foundation Design Specifications

This project looked at the affect of minor settlement in a bridge foundation on the bridge superstructure. The researcher investigated the additional loading on the bridge girders due to movement in the bridge foundation. This project is still under review but most likely a tolerable settlement will be determined and if the settlement exceeds that value, the foundations will be increased. This project should result in smaller foundations by allowing minor settlement.